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SDC Design Note 159

The Effect of Support Cylinder Roundness on the Cold Mass Support Point

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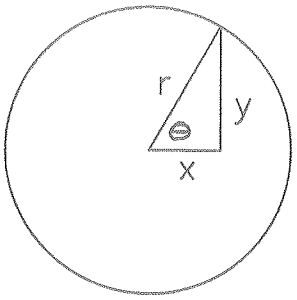
Introduction

Manufacturing and coil winding processes will introduce an out of roundness in the coil support cylinder. This out of roundness has a direct effect on the azimuthal displacement of the cold mass support points. A method of calculating this displacement must be derived in order to determine the greatest possible misalignment seen by the cold mass supports during the assembly phase of the solenoid.

Method

The cold mass support pins shall be located by taking the outer perimeter of the supoort cylinder and dividing it into sixteen equal arc lengths. This will assure that the support points are in the correct angular location when the solenoid is energized. The radius of the cold support points is 75.796". Therefore, when the support cylinder is perfectly round the connection points have the following locations:

Position	Theta (Deg.)	x (Inches)	y (inches)
1.	0	75.796	0.000
2.	11.25	74.340	14.787
3.	22.5	70.027	29.006
4.	33.75	63.022	42.110
5.	45	53.596	53.596
6.	56.25	42.110	63.022
7.	67.5	29.006	70.027
8.	78.75	14.787	74.340
9.	90	0.000	75.796

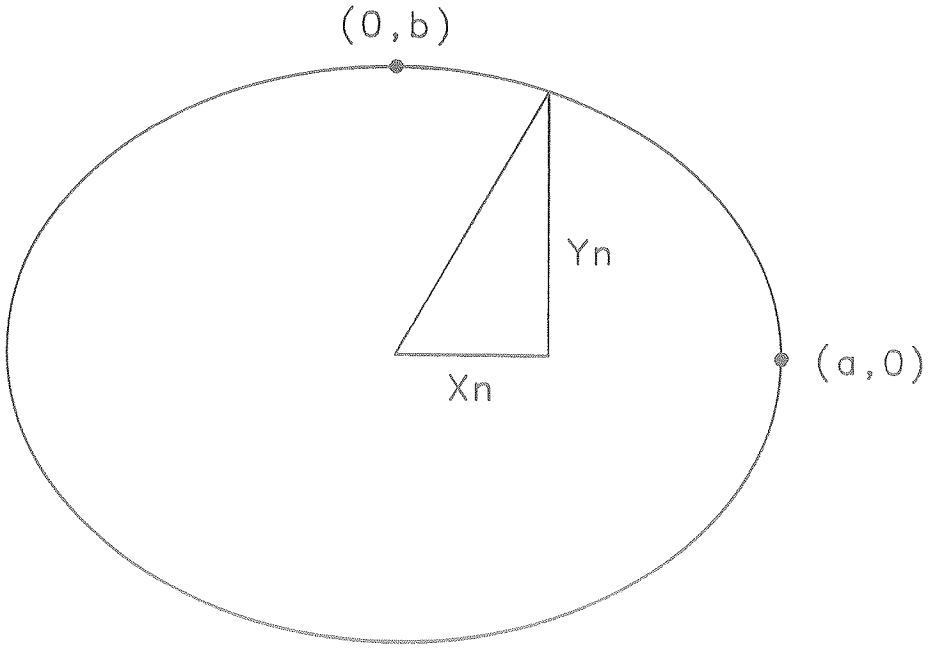


Three cases were considered:

1. The support cylinder is out of round .125" on the outer diameter. (a3 = 75.858", b3 = 75.734")

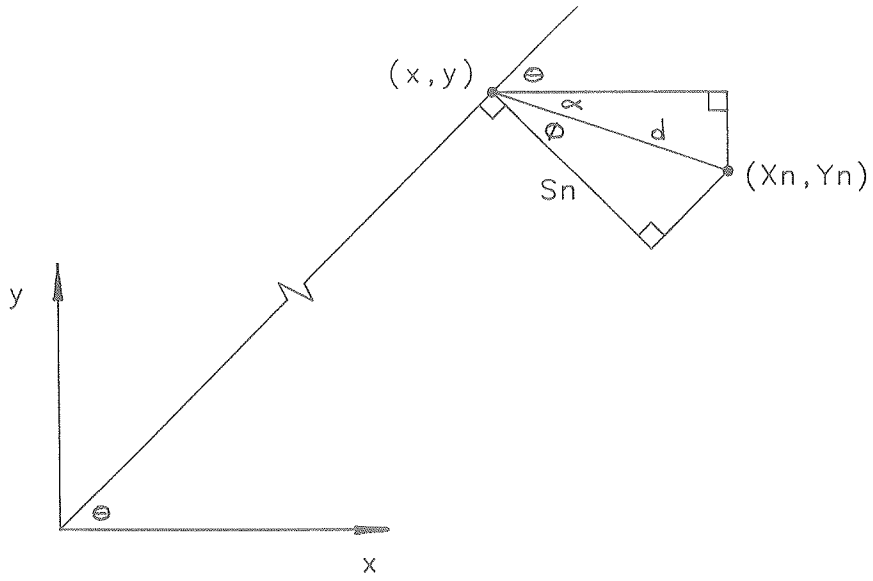
2. The support cylinder is out of round .250" on the outer diameter. (a2 = 75.921", b2 = 75.671")

3. The support cylinder is out of round .375" on the outer diameter. (a1 = 75.983", b1 = 75.609")



If one assumes that the out of roundness causes the outer diameter of the support cylinder to be elliptical, the previous connection points have the following new locations, in inches:

Position	X1	Y1	X2	Y2	X3	Y3
1.	75.858	0.000	75.921	0.000	75.983	0.000
2.	74.398	14.787	74.458	14.786	74.516	14.786
3.	70.075	29.002	70.124	28.999	70.172	28.995
4.	63.057	42.099	63.093	42.088	63.128	42.077
5.	53.618	53.574	53.640	53.552	53.661	53.530
6.	42.121	62.987	42.132	62.951	42.143	62.916
7.	29.010	69.978	29.013	69.929	29.017	69.880
8.	14.788	74.281	14.788	74.222	14.789	74.163
9.	0.000	75.734	0.000	75.671	0.000	75.609



Therefore, the total displacement, d, in inches is determined by:

$$\sqrt{(Xn-x)^2+(Yn-y)^2}$$

and the angle, α, is equal to:

$$\text{Tan}^{-1}\,(Yn-y)/(Xn-x)$$

Hence, the angle, ϕ, is simply:

$$90-(\alpha+\Theta)$$

Thus, the total displacement, Sn, in the azimuthal direction, is:

$$d\cos\phi$$

Therefore, the total azimuthal displacements, in inches, for the previous connection points are as follows:

Position	S1	S2	S3
1.	.000	.000	.000
2.	.011	.024	.035
3.	.022	.044	.066
4.	.029	.057	.086
5.	.031	.062	.093
6.	.029	.057	.086
7.	.022	.044	.066
8.	.012	.024	.036
9.	.000	.000	.000